velop" them. But when these webs do begin to appear, they would naturally be small, and would appear to be rudimentary; so that in this stage they would exactly represent the "wholly untenable doctrine" which Mr. Romanes denounces as an "inversion of Mr. Darwin's teaching." As a matter of fact rudimentary organs on the way to future use can be identified in the aquatic larvæ of the Ephemeræ.

The truth evidently is that the theory of the origin of species by transmutation, involves of neces ity a constant succession of structures which are on the wane, and another succession of structures which are on the stocks. Whether any particular structure now dissociated from use, belongs to the one or to the other class, is a question of evidence from associated facts. But the idea of some structures being on the rise, is an idea inseparable from the theory of evolution as taught by Darwin. Fully persuaded, as I am, that there is a very large amount of truth in that theory, I am equally persuaded that, as yet understood, it is incompetent to solve the most important phenomena of creation. In the hands of Mr. Romanes, and of many others, it is almost reduced to the repetition of mere verbal formulæ, under which anything and everything may be brought, only because they are empty of any definite meaning. The derivation of instinct from experience is an excellent example.

ARGYLL.

Rain-band Spectroscopy Attacked Again

I HAVE just had the honour of receiving a copy of an essay read before the Philosophical Society, Washington, D.C., and printed in the *American Journal of Science* for the present month, wherein I read on p. 209:—

"The results of observations with the rain-band spectroscope are now called in question by many prominent meteorologists. In fact the unsatisfactory nature of the evidence may be easily shown to the satisfaction of any one possessing an instrument. If the spectroscope is first turned to the sky in any direction and afterward to a white wall fifty feet distant, it will be found impossible to distinguish between the appearance of the rain-band as shown by the whole atmosphere and by the layer fifty feet thick."

If this be the most damaging accusation that can be brought up, after the memorable correspondence in both NATURE and the *Times* during the autumn of 1882, there is hope of converting "the prominent meteorologists" yet.

For cannot they, as well as other men, see, that a white wall close to an observer in daylight, necessarily reflects the light, and with that, the spectrum, of the sky which is illumining it, solar lines and telluric lines and all!

Or if the worthy gentlemen still doubt, let them illumine their white wall at midnight with policemen's lanterns or Swan's incandescent lamps; and then I can promise them they will get out of it and the "layer of air fifty feet thick" in front of it, neither solar nor telluric spectrum lines in any kind of weather.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, March 25

The Remarkable Sunsets

IN reply to inquiries sent out by me to Prof. John Milne of the University of Tokio, Japan, I am informed that no volcanic dust was known to have fallen in Japan during or after the Krakatoa eruption. He forwards, however, the following extracts, which may be of interest to your readers.

JOHN W. JUDD

Science Schools, South Kensington, S.W.

"*Japan Gazette, Friday, Sept.* 21, 1883.—Shortly after noon on August 30 the sun seemed to diminish in power, and a uniform yellow gray haze spread over the sky, gradually becoming more pronounced, and at two hours before sunset its rays were merged into a faint halo emerging from a globe of light no larger than the full moon. On Friday, August 31, at 8 a.m., sun the same. At 11 a.m. looked like full moon; could easily observe it with the naked eye. At intervals, faint clouds like puffs of smoke crossed the sun's face; they were enormously high. No wind; atmosphere dull and heavy, and neither heat nor light. September 1, the same. On Sunday, sun became as usual, and haze passed away. The Japanese were alarmed, and expected earthquakes."

Prof. Milne adds the note: "If this were due to Krakatoa, almost 2500 miles away, the speed of the dust must have been thirty miles an hour, assuming the date of the eruption to be 12 p.m. on August 26."

THE coloration of the sky in the neighbourhood of the sun, described by "B. W. S." in NATURE of March 27 (p. 503), has been repeatedly observed by myself from February 20 (or thereabouts) up to March 24. My first record of it is on February 24, when I describe it as a "rusty-red" tint. On other occasions I have called it "rusty brown" and "pale brick-red." Sometimes it has had a purplish or roseate hue. It has been chiefly seen between 10° and 20° from the sun (at a rough estimate), and only when the sun was hidden by a detached cloud. Frequently, when the sky has been clear, the intervention of a house or other object between the observer and the sun has revealed the presence of a hazy metallic-looking glare around the sun—an appearance not perhaps very remarkable in itself, but remarkable by its frequent repetition.

If, as seems probable, the explanation of these phenomena is to be found in a gradual subsidence of the reflecting matter which occasioned the remarkable sunsets, it will be well for observers to be prepared with suitable arrangements for catching what may fall. I have myself had in operation for some time past two separate devices for this purpose, the one intended for dry weather, the other for rain. In dry weather I expose a tray containing a number of glass slides, each with a drop of glycerine in a shallow cell, ready to be covered with this glass after sufficient exposure. For rain I use a 12-inch bell-glass supported in an inverted position on a three-legged stand, the legs partly buried in the earth, and the height such as to raise the receiving area of the glass to 30 inches above the soil. A rain-gauge is less suitable for the purpose, and experience has shown me the necessity of guarding against the introduction of particles of soil by the rebound of hailstones.

An investigation of this kind is difficult in the neighbourhood of a city, and it is much to be wished that observers living in isolated situations may be induced to undertake it.

It may be worth recording that on February 24, after an interval of several weeks, we had a striking recurrence of the sunset phenomena so often described. It was not perhaps the very finest example, but, as regards the primary glow, there had been nothing equal to it since January 12. Unfortunately I was not able to watch for the secondary glow. It is singular that at both the beginning and end of this series of phenomena there should have been outlying examples separated by some weeks from the rest. The first of the peculiar sunsets observed in this country appears to have been on November 9. Then I find no record until November 24. From that date (allowing for interruption by weather) they may perhaps be considered to have been continuous until February 2, becoming scarcely noticeable towards the last. Then, finally, after an entire absence of fully three weeks there comes, on February 24, a sunset which must be ranked amongst the finest of the series.

Clifton, March 31 GEORGE F. BURDER

REFERRING to the "decidedly unusual *pink tinge*" occasionally observed around the sun "when shining in a somewhat hazy sky, the colour being brought out with great distinctness if a light cloud happens to be passing across it" (see NATURE, March 27, p. 503), I would mention that, under the described circumstances, I have often noticed last winter a peculiar colour, to which I would apply the French term *velure d'oignon* (onion skin), used to describe certain kinds of champagne. I offer this suggestion, as I know the value of precise and happily chosen terms, especially in the difficult matter of the terminology of colours.

O. S.

Heidelberg, Germany, March 29

Thread-twisting

THE habit of thread-twisting with the palm of the hand on the thigh is one which may be seen in every part of India at the present day; we think it can hardly be termed a rude method, or a savage art, though the Mohammedans, whose ancestors came not so very long ago from Central Asia, practise it as much as, or even more than, the Hindoos. As "J. S." observes in NATURE of March 20 (p. 478), it may be one of the survivals from a barbarous period which we have lost since the introduction of machinery. Perhaps some of your correspondents may be able

to tell us whether it is in use in the Orkneys and the Hebrides, or elsewhere, where the people still spin their own wool.

COSMOPOLITAN

MEASURING HEIGHTS[1]

THE system of barometric hypsometry described in this treatise—first communicated in 1877 to the Philosophical Society of Washington—was suggested by the needs of the geographical surveys conducted by the Government of the United States in the mountainous region lying between the Great Plains and the Pacific Ocean. The system proposes a new method of observation and computation. It is not of universal application, but the range of work to which it is adapted is large and deserving the attention of the geographer.

The *method of observation* is as follows:—Two base stations are established—one high, the other low. Their difference in altitude is made as great, and their horizontal distance as small, as practicable. Each station is furnished with a barometer only, and observations are made at frequent intervals through each day. At each new station a barometer is observed, and no other instrument. The difference in altitude of the two base stations is determined by spirit level, and forms a vertical base by which all other intermediate altitudes are *computed as follows*:—The readings, being corrected for index error and temperature of instrument, are collected in groups of three, each observation at a new station being accompanied with the simultaneous observations at the two base stations. The resulting difference of heights of the lower and the new station is then computed by the following formula, in which if L, U, N represent the height of the lower, upper, and new stations respectively, and l, u, n the simultaneous corrected barometric readings at the same stations, and also let $B = U - L$, $A = N - L$, and $B - A = U - N$; then it is found approximately that—

$$A = B\frac{\log l - \log n}{\log l - \log u} + \frac{A(B - A)}{D}.$$

where $D = 490{,}000$, if A and B are reckoned in *feet*; or 149,349 if in *metres*. This formula consists of two terms—the first, or *logarithmic term*, is the principal one; the second, or *thermic term* (so called), is always very small in comparison with the first—so that it suffices to substitute for A in the second term the value of the first. The following example of computation further illustrates the formula:—

In August 1872 the simultaneous mean pressures at Sacramento, Colfax, and at Summit were 29·879, 27·475, and 23·336 inches respectively, and the altitude of Summit above Sacramento is 6989 feet. Required the altitude of Colfax above Sacramento. In this case:—

$l = 29{\cdot}879$ $\quad \log l = 1{\cdot}47537$
$n = 27{\cdot}475$ $\quad \log n = 1{\cdot}43894$
$u = 23{\cdot}336$ $\quad \log u = 1{\cdot}36803$
$\log l - \log n = 0{\cdot}03643$
$\log l - \log u = 0{\cdot}10734$

$\log (0{\cdot}03643) = -2{\cdot}56146$
$\log (0{\cdot}10734) = -1{\cdot}03076$

Difference $= -1{\cdot}53076$
$\log B = 3{\cdot}84441 \quad 6989 = B$

sum = log (first term) = 3·37511...2372·0 = first term = A nearly [mately]

$\log (B - A) = 3{\cdot}6644 \ldots 4617 = (B - A)$ (approxi-
colog (490000) $= -6{\cdot}3098 \ldots$

Sum $= 1{\cdot}3493 = \log 22\,4$...the second term

Required difference of altitude = 2394 4 feet.

[1] "A New Method of Measuring Heights by Means of the Barometer." By G. K. Gilbert. Extract from the Annual Report of the Director of the U.S. Geological Survey, 1880-81. (Washington: Government Printing Office, 1882.)

The author, considering the direct calculation of the second term inconvenient, has calculated a table of double-entry showing the value of this term as a correction of the first term for every 100 feet of B and of the approximate value of A, which is appended. A graphic table is also appended (plate lxii.) for computation of this *thermic* correction. However, as the table of logarithms must be to hand, the direct calculation does not seem to present any particular inconvenience.

By thus abandoning the thermometer and psychrometer, and employing the barometer alone, the author reverts to elementary principles upon which all barometric measurements depend, and presents in his first chapter a review of the purposes and conditions of barometric hypsometry in general, and although not presenting anything new, is yet very interesting. The principle which underlies the measurement of heights by the barometer is exceedingly simple, but its application is fraught with difficulty. The law of the relation of altitude to atmospheric pressure is consequent on the law of the compressibility of gases, and is simply a certain multiple of the logarithm of the air-pressure. But there are numerous modifying conditions which must be considered in the application of this law. After describing the construction of barometers, of which the mercurial is both the oldest and the most accurate, the author passes to the consideration of the modifying conditions of the temperature and humidity of the atmosphere which are ever varying, so that the static order of densities is broken, currents are set in motion, and the circulation and the inequalities of temperature conspire to produce inequalities of moisture. Every element of equilibrium is thus set aside, and the air is rendered heterogeneous in composition, temperature, and density. Moreover, the disturbing factors are so multifarious and complex that there is infinite variety of combination and infinite variety of result. Approximate solutions of the problem are therefore only expected; and the author, after describing the disturbing factors—gradients, temperature, humidity—and the various devices for the elimination of the errors due thereto, and other general devices for diminishing hypsometric errors and the relative importance of different sources of error, arrives at the conclusion that the difficulties which inhere in the use of the barometer for the measurement of heights are so numerous and so baffling that there is no reason to hope they will ever be fully overcome. The best that can be done is to mitigate them, keeping in mind that the barometric method must not be so elaborate that its cost will approach that of the use of the spirit level. The problem, therefore, which occupies the attention of those who have occasion to use the barometer in extended surveys is how to secure the best result from a single observation at a new station combined with a series of observations at one or more base stations.

The author next proceeds in the second chapter to develop his *new method*, as explained above, and determines a mean value of the *thermic constant*, D. In Chapter III., on "Comparative Tests," various tables are given of the comparative results obtained by means of the new method and the ordinary and other empirical methods in use. This comparison shows the advantage of the new method in a reduction of one-half the error of the ordinary method, and one-fourth that of the empiric method. Nevertheless there is a considerable range of special cases in which the ordinary method can never be superseded.

Having shown that the new method is theoretically plausible and practically successful, the author considers in the fourth chapter the nature of possible improvements. This chapter, and the following fifth chapter on the limits of utility, and the sixth on the work of others, are more specially addressed to the students of hypsometry. This interesting work closes with a short chapter, the seventh,